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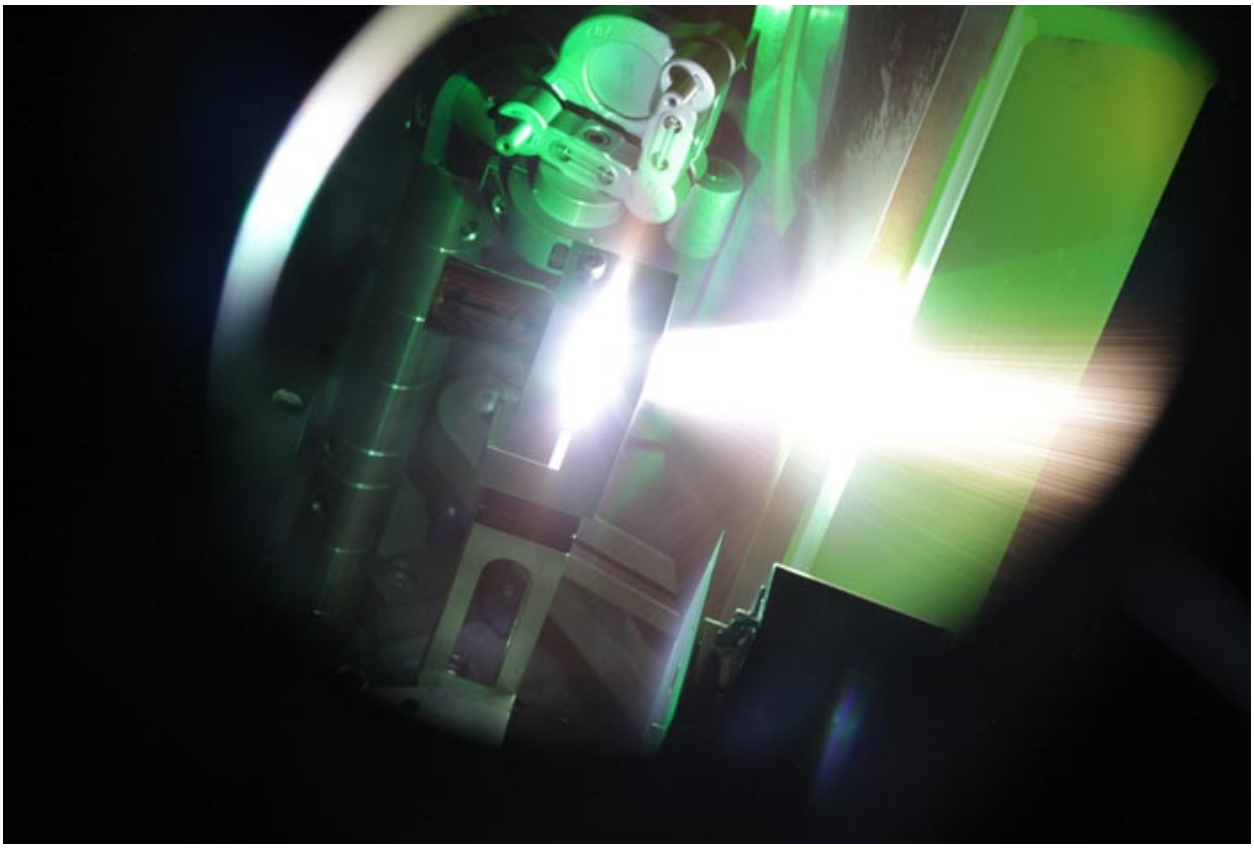

First Time Nuclear Material Detection by One Short-Pulse-Laser-Driven Neutron Source

In a set of experimental campaigns in May 2012 and in August 2012, scientists working at the Trident laser system at LANL created the world's record for short-pulse laser generated neutron flux, cited in various news releases [1,2,3].

One of the main motivations behind developing a bright pulsed neutron source is for the assay of special nuclear materials for accountancy, safeguards and security. Here, an intense neutron burst offers the potential of achieving a high signal-to-noise ratio

in difficult to measure cases (for example the high passive emission rate of spent fuel) and also the important prospect of a short assay time which translates to a high item throughput.

In February 2013, a team of scientists led by A.Favalli (LANL) conducted an experimental campaign at LANL's Trident Facility to explore the feasibility of active interrogation of nuclear material by a laser driven neutron source and to explore the challenging problem of active interrogation of nuclear material by a single pulse. Delayed neutrons were chosen as the signature for nuclear material as these neutrons are characteristic signatures for nuclear fissions (very few other processes yield delayed neutrons). The detection system consisted of two identical neutron detector well counters; one detector containing a 2 kg sample of depleted uranium, and the other one empty for background comparison. A single shot interrogation of the depleted uranium sample, showed a clear signal from the delayed neutrons in the detector with uranium, compared with the background, and with the typical time behavior of delayed neutrons.

The results obtained are the first experimental demonstration of active interrogation of nuclear material by a short pulse laser driven neutron source.

Research Team

A.Favalli and M.Swinhoe of NEN-1 (Technical Contacts) led the research activities. The team is composed of scientists, Post Docs from NEN, P and MST as well as M. Roth from Technical University of Darmstadt. Researchers involved are: J.S.Bridgewater, A.Favalli, D.Henzlova, K.Ianakiev, M.Iliev, M.Swinhoe, (Safeguards Science and Technology, NEN-1), K.Falk, J.Fernandez, D.Gautier, R.P.Johnson, D.Jung, T.Shimada (Plasma Physics, P-24), N.Guler (Neutron Science and Technology, P-23), C.E.Hamilton (Polymers and Coating, MST-7), S.Croft (ORNL), M.Roth (Technical University of Darmstadt, Germany).

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Reference

[1] World Neutron Record Beam, LANL press release, http://int.lanl.gov/news/news_stories/2012/July/07.12_neutron-beam-world-record.shtml

[2] A tabletop neutron source, Nature 494, 9 (07 February 2013), doi:10.1038/494009b

[3] M.Roth, D.Jung, K.Falk, N. Guler, O.Deppert, M.Devlin, A. Favalli, J. Fernandez, D. Gautier, M. Geissel, R. Haight, C. Hamilton, B.M. Hegelich, R.P Johnson, F. Merrill, G. Schaumann, K. Schoenberg, M. Schollmeier, T.Shimada, T. Taddeucci, J. L. Tybo, S. A Wender, C. H Wilde, G. A. Wurden, *A Bright, laser-driven neutron source based on the relativistic transparency of solids*, Physical Review Letters, PRL 110, 044802, 2013